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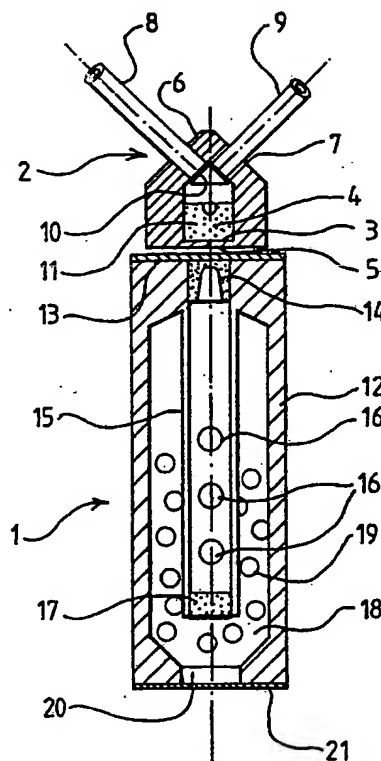
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<b>(21) International Application Number:</b> PCT/SE93/00613 <b>(22) International Filing Date:</b> 6 July 1993 (06.07.93)  <b>(30) Priority data:</b> 9202078-3 6 July 1992 (06.07.92) SE  <b>(71) Applicant (for all designated States except US):</b> AUTOLIV DEVELOPMENT AB [SE/SE]; S-447 83 Vårgårda (SE).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only) :</b> PERSSON, Torsten [SE/SE]; Mellanåsgatan 19, S-691 33 Karlskoga (SE). CARLSSON, Staffan [SE/SE]; Yttre Lötsvängen 30, S-691 33 Karlskoga (SE).		<b>(74) Agent:</b> MEULLER, Erik; Autoliv Development AB, Patent Department, S-447 83 Vårgårda (SE).  <b>(81) Designated States:</b> DE, JP, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).  <b>Published</b> <i>With international search report.</i>

**(54) Title:** A GAS GENERATOR ARRANGEMENT

**(57) Abstract**

A gas generator arrangement comprising a gas generator (1) and an ignition device (2). The ignition device comprises a housing (3) containing a pyrotechnic charge (11) to be activated when the gas generator is to be activated. The gas generator (1) comprises a hermetically sealed gas generator unit comprising a housing (12) defining an opening (which opening is covered by a sealing membrane (13)) which is located adjacent the ignition device (2). A pyrotechnic charge (14) is located adjacent the membrane (13) adapted to be activated in response to activation of the pyrotechnic charge (11) in the ignition device and adapted to initiate combustion of a gas generating pyrotechnic material (19) within the gas generator.



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A Gas Generator Arrangement

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The present invention relates to a gas generator arrangement and more particularly relates to a gas generator arrangement adapted to generate gas to inflate an air bag.

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It has been proposed to provide an air bag in a motor vehicle, the air bag being adapted to be inflated in the event that an accident should arise, the inflated bag providing protection for the driver of the vehicle or a passenger in the vehicle.

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It is a requirement for an air bag in a motor vehicle that the air bag should operate quickly in the event that an accident arises. Thus, the air bag must be fully inflated within a very brief period of time if the air bag is to provide protection in a satisfactory manner. Also, the air bag must be very reliable. In some cases, the air bag totally replaced safety belts, and it is thus imperative that the air bag should be inflated whenever an accident arises. A further factor that must be taken into account when designing an air bag arrangement is that the air bag may remain un-operated for a very long period of time, but must operate reliably whenever an accident occurs. Thus, a motor vehicle incorporating an air bag may be driven for 20 years or more, and the air bag must remain in an operative state for the whole of that period of time.

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In many prior proposed air bag arrangements, the air bag is associated with a crash sensor which consists of

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an electronic unit which, when subjected to a predetermined deceleration, indicative that an accident is occurring, transmits an electrical signal to an electrical igniter present in the gas generator associated with the air bag.

However, it has now been proposed (see WO 93/07440) to generate an ignition pulse not by using an electrical system, but instead by using a pyrotechnic trigger unit, which can generate an ignition pulse which is transmitted by means of a shock tube (such as the shock tube sold under the Trade Mark NONEL) to the gas generator of an air bag. Such a system is therefore independent of electrical power.

From the point of view of stability, it is important for the elements of such a system to be hermetically sealed or substantially leak-tight so that the elements can be stored and handled without any problems arising due to the ingress of moisture. It is also important for the gas generating substances within the gas generator to be ignited correctly to avoid an undesirable pressure rise curve.

The present invention seeks to provide an improved ignition device for use with a gas generator .

According to this invention, there is provided a gas generator arrangement comprising an ignition device and a gas generator, the ignition device comprising a housing containing a pyrotechnic charge to be activated when the gas generator is to be activated, the gas generator comprising a hermetically sealed gas generator unit

comprising a housing defining an opening therein, which opening is covered by a sealing membrane, the sealing membrane being located adjacent the ignition device, therebeing a charge located adjacent the membrane adapted to be activated in response to activation of the pyrotechnic charge in the ignition device and adapted to initiate combustion of a gas generating pyrotechnic material within the gas generator.

Whilst the charge located adjacent the membrane may be the main charge of gas generating pyrotechnic material, preferably, the said charge located adjacent the membrane is a relay charge. Thus, in operation of the device, the relay charge is initially activated, and the relay charge, in turn, ignites the gas generating pyrotechnic material.

Preferably, the ignition device is associated with at least one shock tube, the arrangement being such that a shock pulse present on the shock tube will initiate the pyrotechnic charge within the ignition device. Conveniently, the ignition device is associated with two or more shock tubes. Preferably, each shock tube is associated with a non-return valve mechanism to prevent a shock transmitted to the ignition device by one shock tube being transferred to another of said shock tubes.

Preferably, the ignition device comprises a housing defining a chamber receiving the pyrotechnic charge, that chamber being sealed by means of a membrane which is located adjacent the gas generator. Advantageously, the membrane is a metal or plastic foil.

Preferably, the receptor charge in the gas generator is associated with a flame guide adapted to directed flame from the receptor charge to a gas generating pyrotechnic material.

Advantageously, the flame guide comprises a substantially tubular wall provided with apertures or openings therein separating a path for the flame from a region containing the pyrotechnic material.

In one embodiment, the flame guide is in the form of an elongate tube.

Preferably, a repeater pyrotechnic charge is provided at the free end of the elongate tube.

In an alternative embodiment, the flame guide is defined between a wall defining a bore within the housing and a bell-shaped element located within the bore.

Conveniently, the bell-shaped element is adapted to move, in response to ignition of gas generated pyrotechnic material contained within the bell-shaped element, to seal one end of the bore. Advantageously, the gas generator housing is provided with one or more outlet ports for gas generated by combustion of the pyrotechnic material. Preferably, the or each outlet port is initially sealed by means of a detonation plate adapted to burst at a predetermined pressure.

Preferably, the or each outlet port comprises an erodible nozzle which, due to erosion will change its

opening area during the combustion process.

Conveniently, the gas generating pyrotechnic material comprises NC gunpowder, Na acid, TAGN (triaminoguanadine nitrate) or LOVA gun powder (low vulnerability ammunition gun powder). Advantageously, the gas generating pyrotechnic material comprises one or more tablets or pills, loose granules, or grains, flakes or perforated bodies.

In order that the invention may be more readily understood and so that further features thereof may be appreciated, the invention will now be described, by way of example, with reference to the accompanying drawings in which

Figure 1 is a sectional view of one embodiment of a gas generator and an associated ignition device and Figure 2 is a cross-sectional view of an alternative form of gas generator and ignition device.

Referring initially to Figure 1, a gas generator 1 is illustrated, associated with an ignition device 2. The ignition device 2 comprises a housing 3 defining a central chamber or cavity 4, that chamber or cavity being sealed by means of a diaphragm 5 formed of a foil of plastic or metal.

The housing 3 defines two inlet bores 6,7 each of which receives the terminal portion of a respective shock tube 8,9. Each shock tube may be of the type sold under

the Trade Mark "NONEL". Associated with the termination of each shock tube is a non-return valve 10 located within the chamber 4. The non-return valve may comprise a spring biased flap associated with each shock tube 8,9 or may comprise a conical member pivotally mounted presenting flat faces adapted to abut either the end of the shock tube or the end of the shock tube 9.

Contained within the cavity 4 is a pyrotechnic triggering charge 11.

The gas generator comprises a generally cylindrical housing 12 having a substantially hollow interior. The end of the housing 12 adjacent the membrane 5 is sealed by a membrane 13 which may be of metal or plastic. Located within the housing 12 immediately adjacent the membrane 13 is a relay pyrotechnic charge 14. The pyrotechnic charge 14 is mounted at one end of a tube 15 which extends axially of the housing 12, the tube 15 being provided with a plurality of apertures 16 formed in the side wall of the tube. The exterior of the tube 15 defines a flame guide. A second or repeater pyrotechnic charge 17 is provided at the end of the tube 15 remote from the charge 14.

The housing 12 defines a cavity 18 which surrounds the tube 15. The cavity 18 contains a gas producing pyrotechnic material 19. This may consist of NC gun powder, Na acid, TAGN (triaminoguanadine nitrate) or LODA gun powder (low vulnerability ammunition gun powder). The pyrotechnic material may be in the form of pills or tablets, loose granules, grains, flakes or perforated bodies.



5           The cavity 18 is adapted to communicate with the exterior of the housing 12 through an outlet port 20 which is initially sealed by means of a detonation plate 21, which may be made of metal or plastic.

10           The outlet port 20 may comprise an erodible nozzle adapted to change its opening area during the combustion process of the gas producing pyrotechnic material.

15           It is to be noted that the gas generator 1 is totally hermetically sealed, and the ignition device 2 is also hermetically sealed.

20           It is envisaged that the shock tubes 8 and 9 will be connected to crash sensors each adapted to generate a shock pulse within the respective shock tube in response to an accident occurring. When a shock pulse is present on one of the shock tubes, (for example, the shock tube 8) the shock will travel along the shock tube and emerge from the end of the shock tube in to the chamber 4. The shock will serve to actuate the non-return valve mechanism 10 in such a way that the shock can pass from the shock tube 8 into the cavity 4 whilst sealing the end of the shock tube 9, thus preventing any shock from travelling along the shock tube 9.

25           The shock entering the cavity 4 will ignite the pyrotechnic relay charge 11 which will rupture the membrane 5. The shock will pass the small gap between the membrane 5 and the membrane 13, and will penetrate the membrane 13 to activate the repeater pyrotechnic charge 14. The shock

5 wave or flame from the pyrotechnic charge 14 will travel  
down the tube 15, passing through the apertures 16 to  
ignite the pyrotechnic material 19. The number and  
position of the aperture position 16 is selected so that  
the gas generating pyrotechnic material 19 is "over  
10 ignited". That is to say, the pyrotechnic material 19 is  
thoroughly ignited at a number of different points, to  
ensure that the pressure of gas generated does not display  
undesirable pressure peaks and to ensure controlled  
burning. Such controlled burning must be such as to  
prevent unburnt pyrotechnic material being ejected from the  
gas generator, since if unburnt material is ejected, this  
15 could lead to a situation where the material is later  
ignited and burns holes in the airbags which is being  
inflated. Also the gas generating pyrotechnic material is  
"over ignited" to obviate any risk of the combustion  
process ceasing when the detonation plate 21 bursts, as  
will be described below.

20 When the pressure generated by the combustion of  
the gas products pyrotechnic material 19 reaches a  
predetermined limit, the detonation plate 21 bursts, and  
gas flows through the outlet nozzle 20. The outlet nozzle  
25 20 is an erodible nozzle which, due to erosion, changes its  
opening area during the combustion process. Thus, the  
cross-sectional area of the nozzle enlarges as the  
combustion proceeds. This gives a desirable characteristic  
to the flow of gas, there being a low flow rate when the  
30 volume of the air bag being inflated is relatively low and  
a high flow rate when the volume of the air bag being  
inflated is larger.

Figure 2 illustrates a second embodiment of the invention comprising a gas generator 25 and an ignition device 26. The ignition device 26 comprises a housing 27 defining a chamber 28 which is sealed by means of a membrane 29, the chamber containing a pyrotechnic charge 30. The housing 26 defines an inlet bore 31 which receives one end of a shock tube 32.

The gas generator 25 comprises a generally cylindrical housing 33 having an internal bore which defines a first portion 34 of relatively large diameter connected by a narrowing neck portion 35 to a terminal portion 36 of a relatively small diameter, which extends to the end of the housing 33 adjacent the ignition device 26. The end of the housing, and the end of the portion 36 of the bore of relatively small diameter, is sealed by means of a sealing membrane 37 which may be formed of metal or plastic. Contained within the bore portion 36 of relatively small diameter is a receptor pyrotechnic charge 38.

Contained within the first portion 34 of the bore is cup shaped element 39 having a generally cylindrical portion with a tubular wall 40 of a diameter slightly less than the diameter of the portion 34 of the bore, the cylindrical portion 40 terminating with a closure 41 of a shape corresponding to the shape of the inwardly directed neck 35. A plurality of apertures 42 are formed at appropriate positions in the tubular side wall defining the cylindrical portion 40 of the cup shaped element 39.

A channel 43 is defined between the cup 39 and the wall defining the bore 34, 35.

5            Contained within the cup is a pyrotechnic material  
44 which may be the same as the pyrotechnic material of  
Figure 1. The cup has a lower open end which is initially  
sealed by means of a membrane 45 which simply serves to  
retain the pyrotechnic material within the cup. The  
10            membrane 45 serves to separate the interior of the cup from  
a distribution plenum chamber 46 which is associated with  
three outlet ports 48,49 each outlet port being closed by  
a detonation plate 51,52.

15            It is envisaged that when the embodiment of Figure  
2 is to be activated a shock pulse will pass down the shock  
tube 32, into the chamber 28 and ignite the relay  
pyrotechnic charge 30. The membrane 29 will be ruptured  
and the shock pulse will pass through the membrane 37 to  
ignite the receptor pyrotechnic charge 38 within the  
20            portion 36 of relatively small diameter of the bore within  
the housing 33. The shock and/or flame from the receptor  
pyrotechnic charge 36 will flow down the passage 43 between  
the cup 39 and the inner wall of the bore, passing through  
the aperture 42 to thoroughly ignite (or "over ignite") the  
25            pyrotechnic material 44. The pressure generated will  
rupture the membrane 45 enabling the gas generated by the  
combustion of the gas generating pyrotechnic material 44 to  
enter to plenum chamber 46. The rise of pressure may cause  
cup 39 to move so that the closure 41 firmly abuts the  
30            portion of the bore within the housing 33 defining the  
narrowing neck 35, thus effectively sealing the upper end

of the housing, in the orientation illustrated in Figure 2. It is to be observed that the cylindrical portion 40 of the cup carries a terminal outwardly directed flange which slidingly engages the wall defining the portion 34 of the bore of greatest diameter so that the cup is guided to a good sealing position.

When the pressure in the plenum chamber 46 has been raised to a predetermined level, the detonation plates 50, 51 and 52 will break, thus permitting gas to escape from the gas generator to inflate the associated air bag.

The outlet ports 47, 48 and 49 may be erodible nozzles which, due to erosion change their effective cross-sectional area during the combustion process of the pyrotechnic material 44.

It is to be appreciated that the ignition devices as above include gas generators which may be totally hermetically sealed.

CLAIMS :

- 5           1.       A gas generator arrangement comprising an ignition device and a gas generator, the ignition device comprising a housing containing a pyrotechnic charge to be activated when the gas generator is to be activated, the gas generator comprising a hermetically sealed gas generator unit comprising a housing defining an opening therein, 10 which opening is covered by a sealing membrane, the sealing membrane being located adjacent the ignition device, therebeing a charge located adjacent the membrane adapted to be activated in response to activation of the pyrotechnic charge in the ignition device and adapted to 15 initiate combustion of a gas generating pyrotechnic material within the gas generator.
- 20           2.       An arrangement according to Claim 1, wherein the said charge located adjacent the membrane is a relay charge.
- 25           3.       An arrangement according to Claim 1 or 2, wherein the ignition device is associated with at least one shock tube, the arrangement being such that a shock pulse present on the shock tube will initiate the pyrotechnic charge within the ignition device.
- 30           4.       An arrangement according to Claim 1, 2 or 3 wherein the ignition device is associated with two or more shock tubes.
- 35           5.       An arrangement according to Claim 4 wherein each shock tube is associated with a non-return valve mechanism

to prevent a shock transmitted to the ignition device by one shock tube being transferred to another of said shock tubes.

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6. An arrangement accordingly to any one of the preceding claims wherein the ignition device comprises a housing defining a chamber receiving the pyrotechnic charge, that chamber being sealed by means of a membrane which is located adjacent the gas generator.

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7. An arrangement according to Claim 6 wherein the membrane is a metal or plastic foil.

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8. An arrangement according to Claim 2 or any claim dependent thereon wherein the receptor charge in the gas generator is associated with a flame guide adapted to directed flame from the receptor charge to a gas generating pyrotechnic material.

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9. An arrangement according to Claim 8 wherein the flame guide comprises a substantially tubular wall provided with apertures or openings therein separating a path for the flame from a region containing the pyrotechnic material.

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10. An arrangement according to Claim 9 wherein the flame guide is in the form of an elongate tube.

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11. An arrangement according to Claim 10 wherein a repeater pyrotechnic charge is provided at the free end of the elongate tube.

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12. An arrangement according to Claim 9 wherein the flame guide is defined between a wall defining a bore within the housing and a bell-shaped element located within the bore.

13. An arrangement according to Claim 12 wherein the bell-shaped element is adapted to move, in response to ignition of gas generated pyrotechnic material contained within the bell-shaped element, to seal one end of the bore.

14. An arrangement according to any one of Claims 1 to 13 wherein the gas generator housing is provided with one or more outlet ports for gas generated by combustion of the pyrotechnic material.

15. An arrangement according to Claim 14 wherein the or each outlet port is initially sealed by means of a detonation plate adapted to burst at a predetermined pressure.

16. An arrangement according to Claim 14 to 15 wherein the or each outlet port comprises an erodible nozzle which, due to erosion will change its opening area during the combustion process.

17. An arrangement according to any one of the preceding claims wherein the gas generating pyrotechnic material comprises NC gunpowder, Na acid, TAGN (triaminoguanadine nitrate) or LOVA gun powder (low vulnerability ammunition gun powder).



18. An arrangement according to any one of the preceding claims wherein the gas generating pyrotechnic material comprises one or more tablets or pills, loose granules, or grains, flakes or perforated bodies.

19. A gas generator arrangement substantially as herein described with reference to and as shown in Figure 1 of the accompanying drawings.

20. A gas generator arrangement substantially as hereinbefore described with reference to and as shown in Figure 2 of the accompanying drawings.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00613

## A. CLASSIFICATION OF SUBJECT MATTER

IPC5: B60R 21/26 // F42D 1/04, F42C 3/22

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC5: B60R, F42D, F42C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.

☐ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

## \* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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Date of the actual completion of the international search

21 October 1993

Date of mailing of the international search report

02 -11- 1993

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 93/00613

## Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☒ Claims Nos.: 19, 20  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
  
The claims do not comply with PCT Rule 6.2(a) because they rely on references to figures 1 and 2 respectively of the drawings.
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.